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Mapping urban cultural elements to mission planning information requirements: an ontologic approach

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# **Mapping urban cultural elements to mission planning information requirements: an ontologic approach**

**Mr. Jeff Burkhalter**  
**US Army Engineer Research & Development Center**  
**Construction Engineering Research Laboratory**

**76<sup>th</sup> MORS Symposium**  
**June 2008**

# Overview

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- **Introduction**
- **Problem Space**
- **Geo-cultural analysis**
- **Mission rules ontology**
- **Sample**
- **Summary**

# Problem Space

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- In a data-rich, complex, and dynamic urban battlespace, how do we better enable the execution of the IPB in a cultural context?
- Goal: Impact the first two steps of the IPB:

## Define the Urban Environment

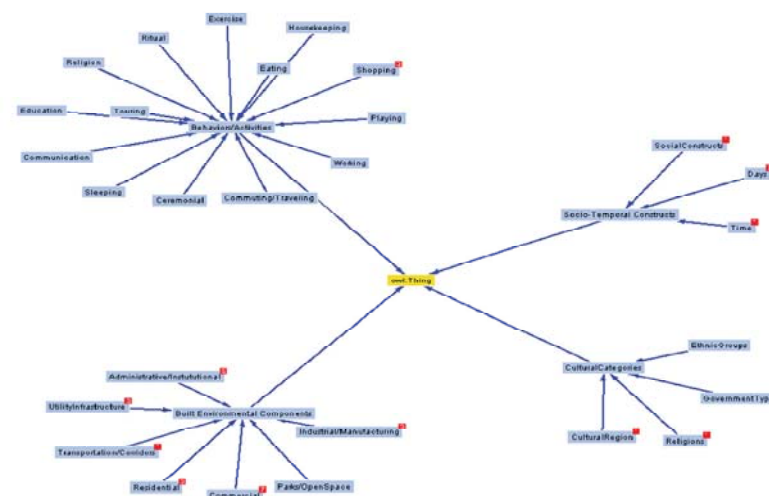
- Area of Operations
- Area of Interest
- Identifying Intelligence/Product Gaps
- Operational Environment

## Define the Urban Environment's Effects

- Terrain analysis
- Civil considerations
- Weather analysis

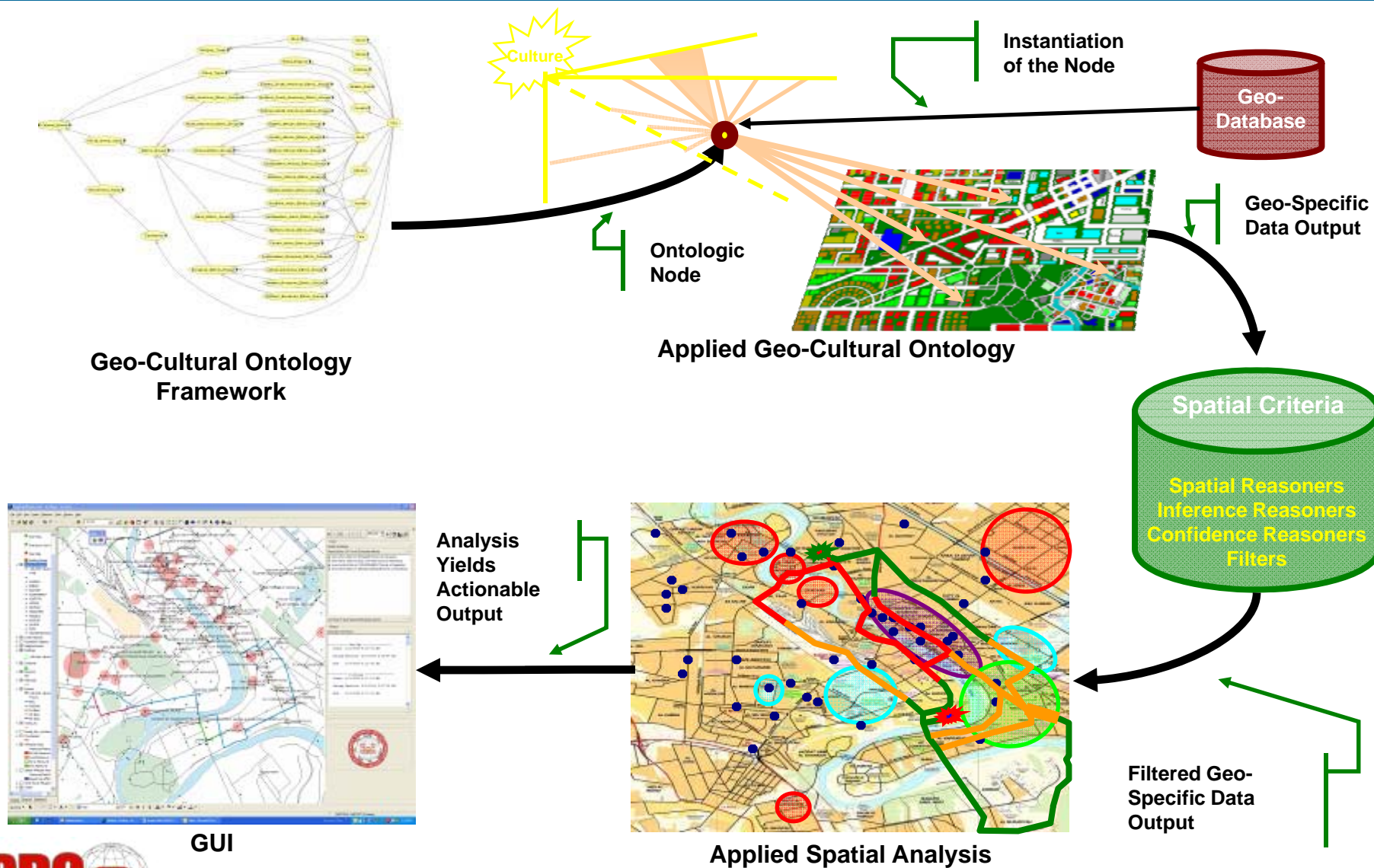
# Geo-Cultural Analysis

- Based on concept of time-geography applied at the cohort demographic level.
- Process of identifying cultural influence on behaviors and practices attributed with a spatial and temporal metric.
- Recognizes that most human behavior and its byproducts (e.g., structures, pathways, practices, etc.) are manifested in the built environment, both spatially and temporally.





# Analysis Workflow



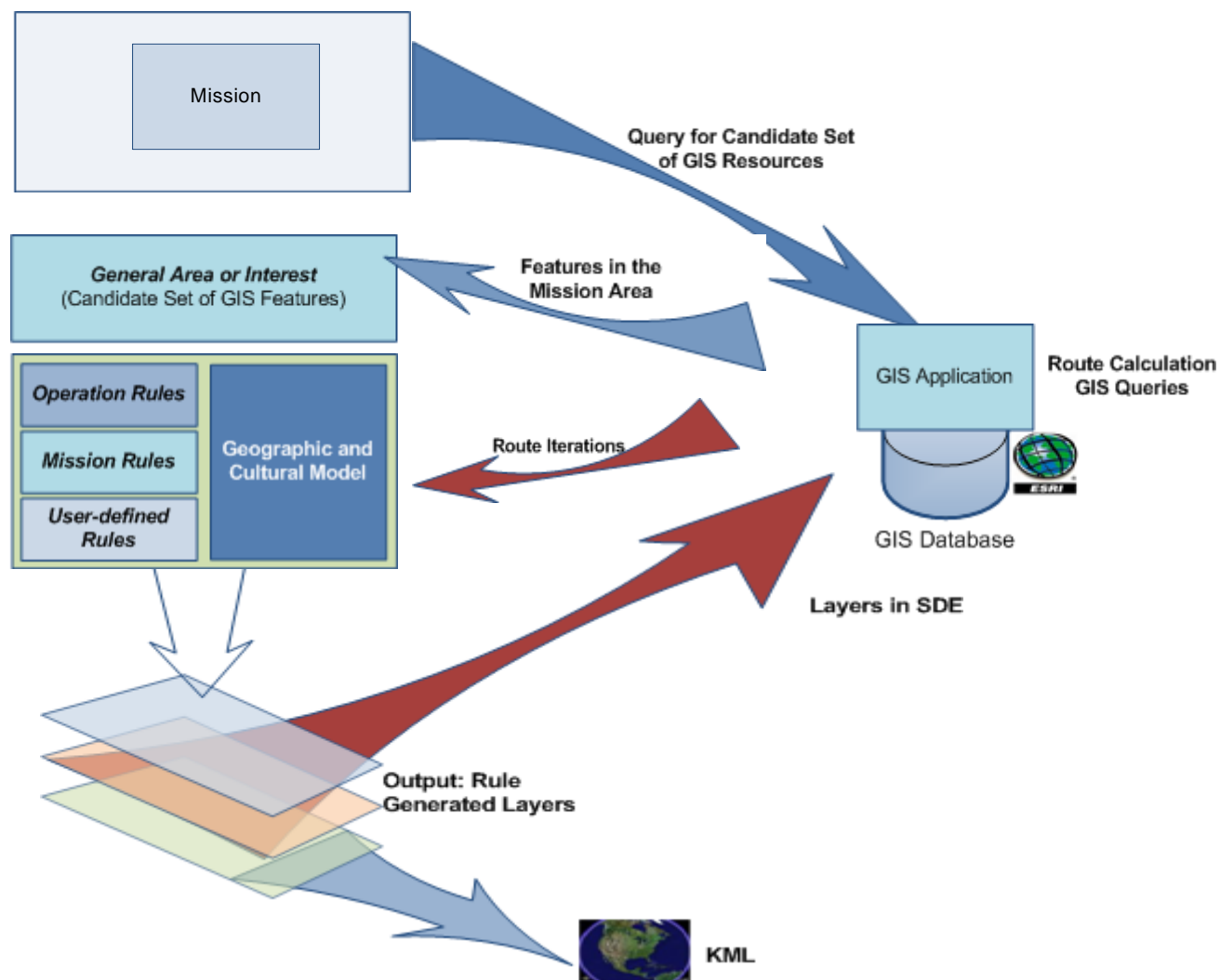
# Ontology Primer

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- **An Ontology is composed of a set of concepts, their definitions and their relations which can be used to describe and reason about a domain** *(C. Hudelot et al, 2008)*
- **Based on description logics (DL)**
  - **Characterized by a set of constructors that can be used to build complex concepts and relationships from basic entities**
- **Ontologies are:**
  - **A set of classes of hierarchical objects classes**
  - **Inclusive of attributes that help define object classes**
  - **Have simple or complex relationships that define the interactions between object classes**
  - **Have reciprocal relationships**
- **Ontologies are NOT:**
  - **Relational databases**
  - **Taxonomies (basic classification of objects)**



# Concept Overview



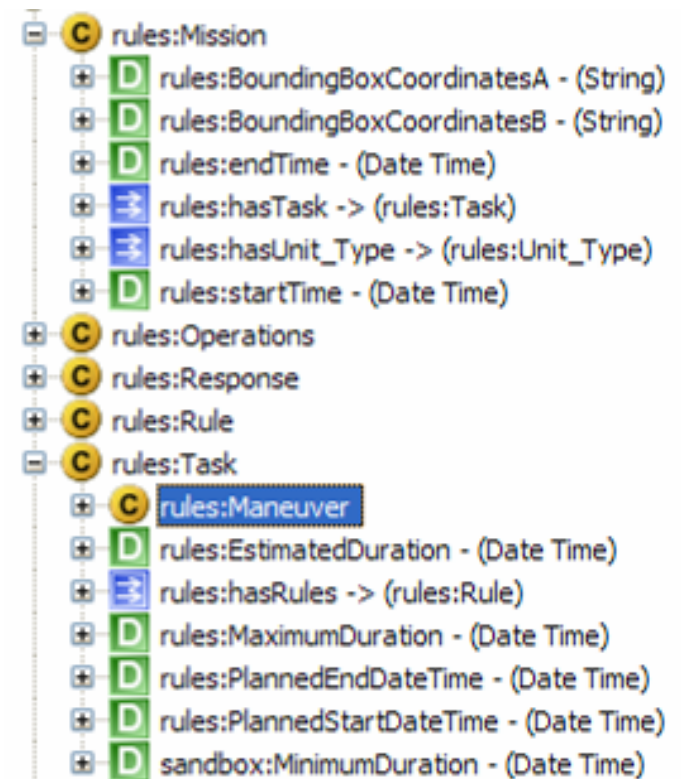
# Mission Rules Ontology

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- **Model planning process for civil considerations (ASCOPE)**
- **Structure**
  - **Defining the Mission**
    - **What's the Plan?**
  - **Defining the Tasks**
    - **What exactly are we doing?**
  - **Defining the Rules**
    - **What do I want to know?**

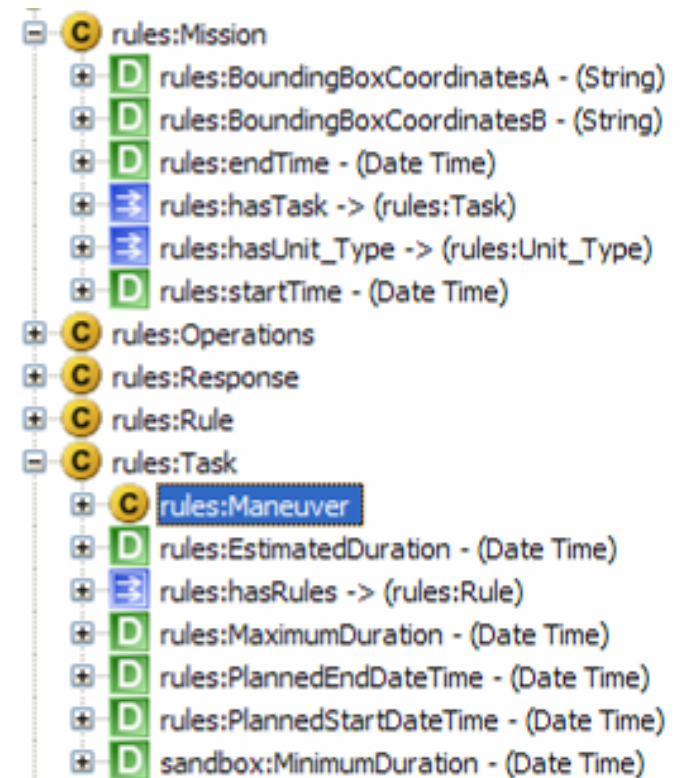
# Defining the Mission

- Schema source is based on JC3IEDM
- Missions are defined by:
  - Description (what)
  - Location (where)
  - Time (when)
  - Units (who)
  - Tasks



# Defining the Tasks

- Schema source is based on the Battlefield Operating Systems (BOS)
- Tasks are defined by:
  - Class (BOS)
  - Type (AUTL or ARTEP)
  - Description (instance)
  - Time (when)



# Defining the Rules

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- **Schema is based on the Geo-cultural ontology and categories of utility**
- **Rules are defined by:**
  - **Class (utility)**
  - **Response (what do I do with it?)**
  - **Buffer (standoff)**

# Rule Classes

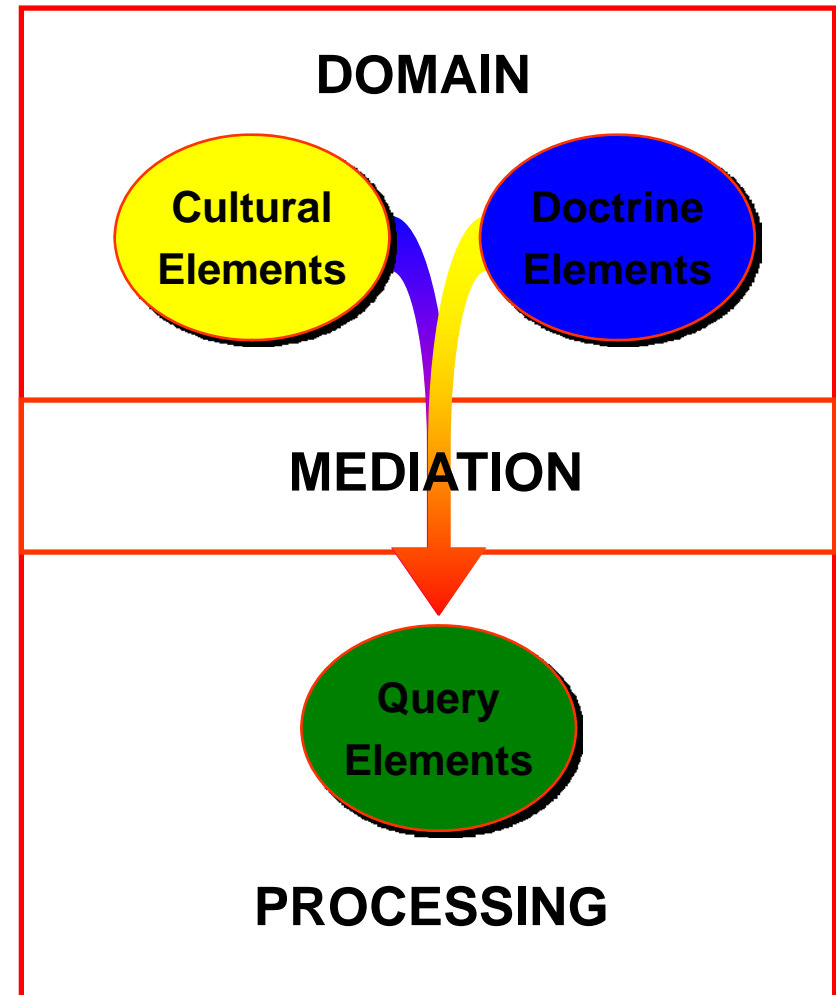
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- **Rules of War**
  - Geneva Convention (FM 27-10)
  - Ex: Identify and protect cultural institutions
- **Rules of Engagement**
  - Theater or Operational mandates
  - Ex: Do not engage forces within a mosque without commander's approval
- **Rules of Doctrine**
  - Guidance based on FM/ARTEP/TTP
  - Manual identification by SME
  - Ex: Avoid routes that limit mobility speed
- **Rules of Personalization**
  - Guidance based on unit experience or local commander guidance
  - Ex: Avoid market areas from 1500-1700



# Mission Rules Ontology

- Reasoning
  - Relating Mission to Tasks
  - Relating Tasks to Rules
  - Connecting to Urban Cultural Elements
  - Rule De-confliction



# Relating Missions to Tasks

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- Primary source of task information supplied by incoming mission parameters from C2 system (BML)
- Doctrinal task name is required in XML conformant format
- Based on doctrinal task name, they are identified by BOS type
- Future capability would enable dynamic generation of task and association with BOS if the data is incomplete
- Number of task associations
  - Mission to tasks (1:n)
  - Tasks that may apply across full mission spectrum that do not have a direct spatial and/or temporal context tend to drop off

# Relating Tasks to Rules

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- **Where do the tasks come from?**
  - **Army Universal Task List**
  - **ARTEP Tasks**
  
- **How are the rules assigned to particular tasks?**
  - **Associate rules based on SME input**
  - **Develop a collection of rules for each task**
    - **Operation type**
    - **Collective task**
    - **Battlefield operating system**
  
- **How many rules are there?**
  - **Rules to tasks (1:n)**
  - **No theoretical limit, however, usability limitations exist**

# Connecting to Urban Cultural Elements

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- **Other ontologies**
  - **Resolve some ambiguity in generic rules**
- **Managed data sources**
  - **Instance data from within the deployed unit**
- **Unmanaged data sources**
  - **Data held by other units/agencies**
  - **Incorporate coalition and national level data sources**

# Output Query

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- Identification of BEF type
- Passes cost surface value and corresponding response text to GIS layers
- Standoff metric value table stored independently
- Query framed in the spatial-temporal context of original mission profile
- Thinkmap<sub>TM</sub> software embedded as on-the-fly parameter adjustment

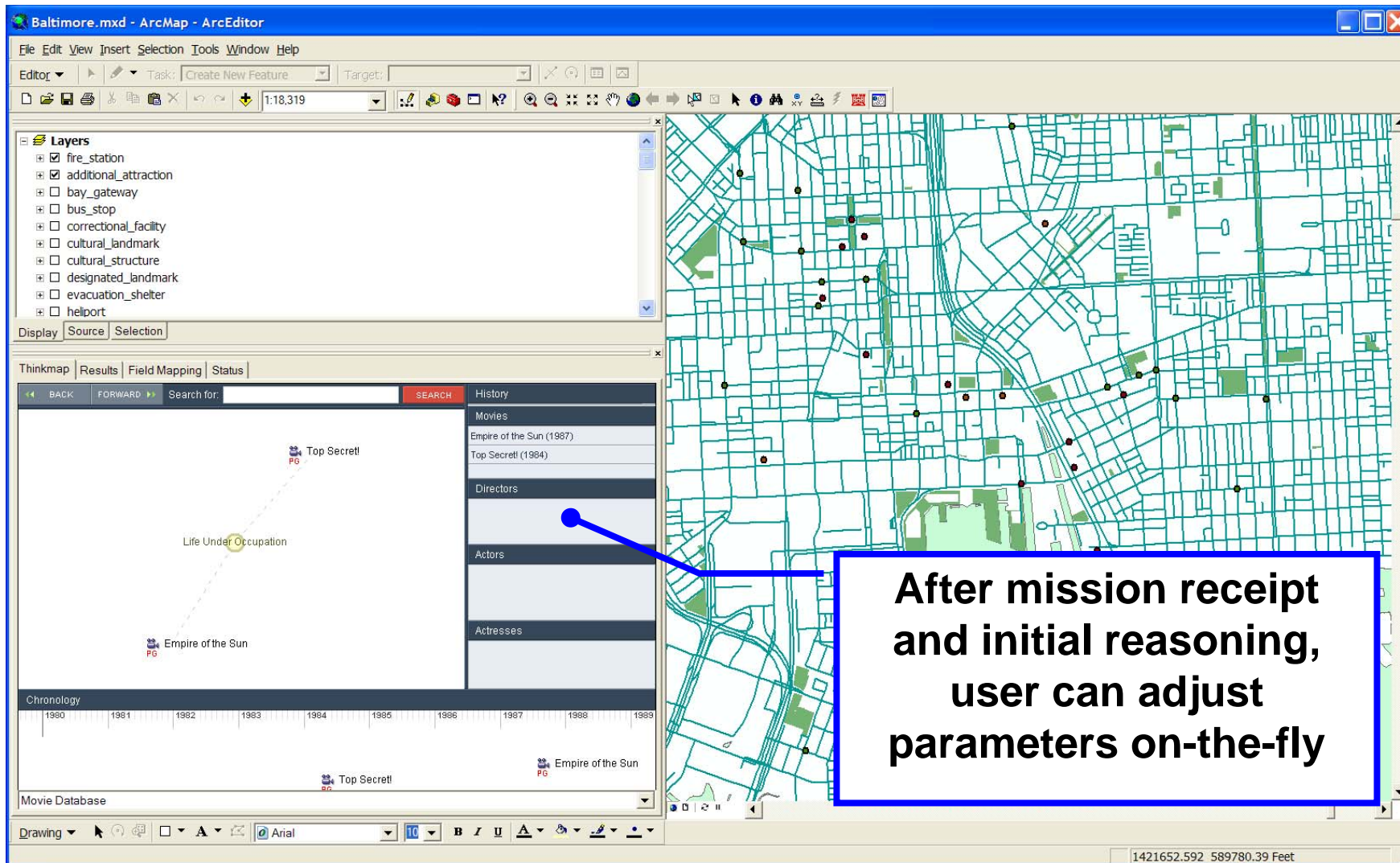
# Rule De-confliction

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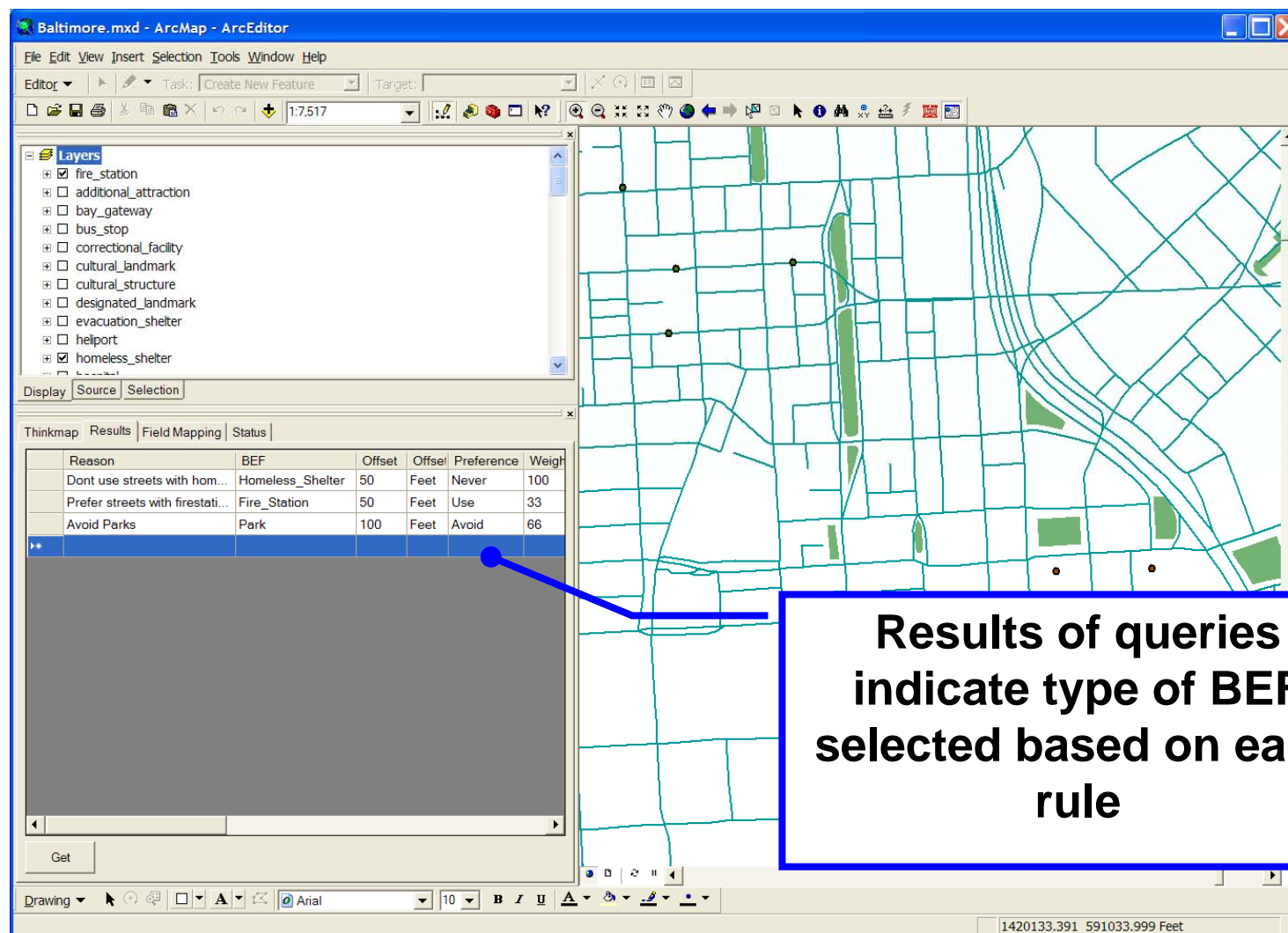
- **Potential conflicts:**
  - **Overlapping cost areas**
  - **Overlap of absolute cost measure**
  - **Multiple rules acting on individual instances of urban features**
- **Separate cost surface layers**
- **Burden of de-confliction on user**



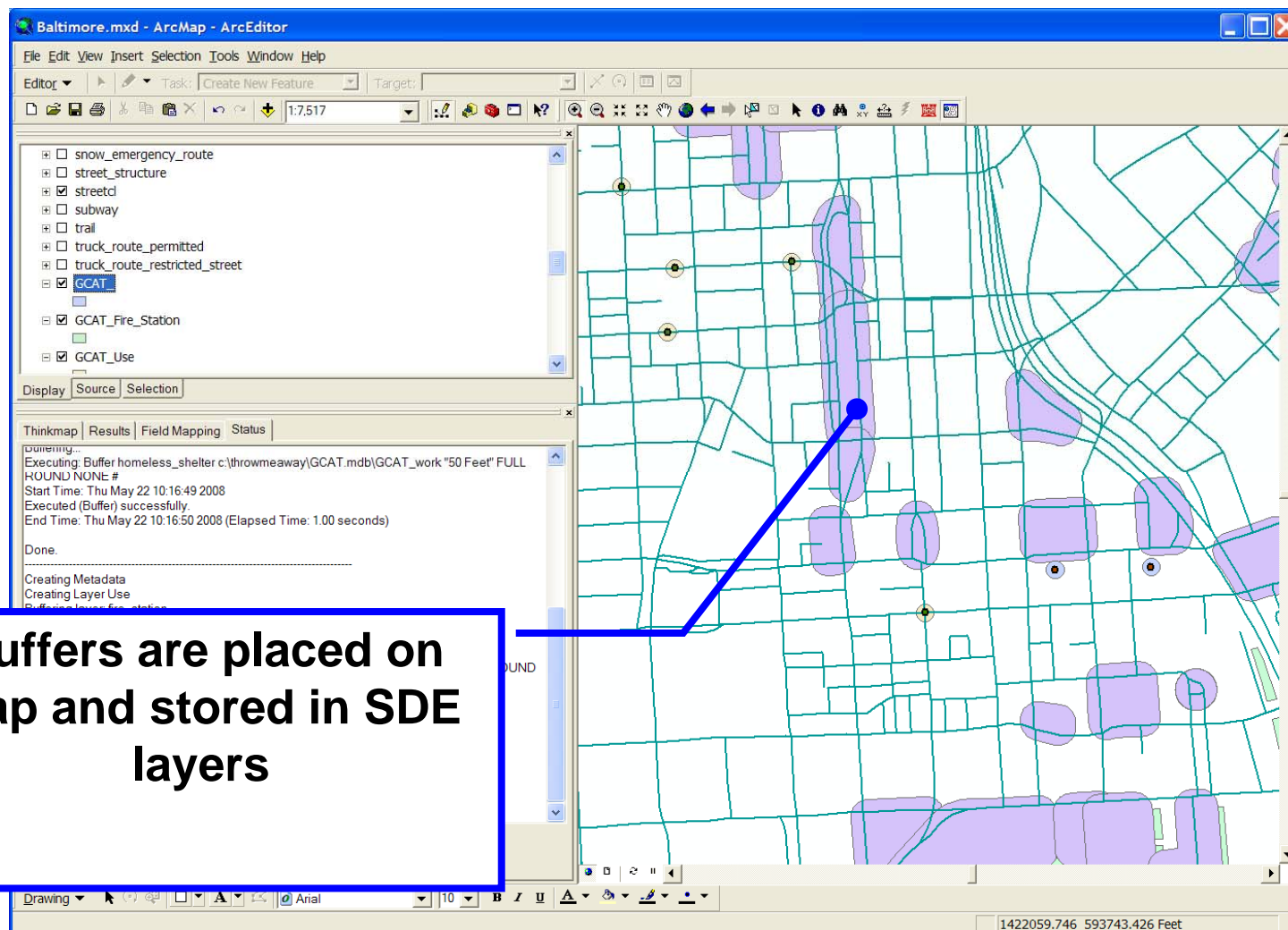
# Sample



# Sample



# Sample



**Buffers are placed on  
map and stored in SDE  
layers**

# Sample

Baltimore.mxd - ArcMap - ArcEditor

Identify

Identify from: <Top-most layer>

GCAT\_Never  
PRESTON GARDENS

Location: 1,421,642.108 592,563.599 Feet

Field	Value
OBJECTID_1	852
Shape	Polygon
GCAT_Source	GCAT
GCAT_Reason	Avoid Parks
GCAT_Mission	Cordon and Search
GCAT_Task_Name	Tactical March from FOB Silver to Objective
GCAT_Task_Instance	Tactical Road March
GCAT_BEI_Activity_Start_Time	0000
GCAT_BEI_Activity_Duration	0900
GCAT_Weight	66
GCAT_Preference	Avoid
GCAT_Ruleset	Rules of War
OBJECTID	0
BLOCKLOT	0609 NONE
NAME	PRESTON GARDENS
ADDRESS	
DIR	C
TAZ	C
GRANT_INVE	URBAN RENEWAL
NOTES	park
BLOCK_NO	0609
LOT_NO	NONE
PGREN	
PS	
FN	
MS	

Each response type reflected in a separate layer, where user decides on thresholds

Drawing

1421642.108 592563.599 Feet

# Summary

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- **Mechanism for populating culturally related data expected to be part of the CCIR based on mission profile**
- **Implement existing data/model standards to reduce semantic heterogeneity**
- **Way ahead:**
  - **Additional reasoning to be added which includes more complex queries**
  - **Improve cost-surface calculation and incorporate basic deconfliction**
  - **Implement operation-type reasoners and higher HQ inference**
  - **Traversal ontology to connect with unmanaged data sources and alternate C2 formats**



# POC

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